

3-D Image of Urban Areas and Mountains of the Northern Front Range, Colorado

by Neil S. Fishman, John M. Evans, Robert J. Olmstead, and William H. Langer

Front Range Infrastructure Resources Project



Pamphlet to accompany
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3-D Image of Urban Areas and Mountains of the Northern Front Range, Colorado

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Introduction

Over the past 30 years, communities in the Northern Front Range of Colorado have experienced tremendous growth rivaling or surpassing that in other parts of the United States. This growth has challenged businesses as well as city, county, State, and Federal planners to meet the increasing demands for natural resources necessary for growth. Such resources include construction aggregate (stone, sand, and gravel), water, oil, and natural gas. The Front Range Infrastructure Resources Project (FRIRP) of the U.S. Geological Survey (USGS) is in the process of studying these resources, and this publication is the first in a series (USGS Geologic Investigations Series I-2750) that deals with resources in the northern Front Range urban corridor. This publication is intended to serve two functions:

1. The 3-D (three-dimensional) image can be used by the general public, businesses, and city, county, State, and Federal agencies for a variety of purposes. Because the image is available in digital form as well as printed on paper, users can modify the image to suit their individual needs.
2. Using this 3-D image as a base map, companion publications will show the distribution of resources in the northern Front Range urban corridor and the effects of resource extraction. These publications will be released as USGS Geologic Investigations Series I-2750-B, I-2750-C, and so on.

The area of the 3-D image comprises much of the northern Front Range urban corridor, which includes the Denver metropolitan area and the rapidly growing areas in western Adams, western Arapahoe, eastern Boulder, southeastern Larimer, southwestern Weld, northern Douglas, and Jefferson Counties (fig. 1). The boundary between the Rocky Mountains to the west and the Great Plains to the east is also within the image (fig. 1). In this pamphlet we briefly describe the nature and goals of the FRIRP and also provide details as to how the image was constructed.

Front Range Infrastructure Resources Project

Infrastructure, which includes roads, airports, water and energy transmission and distribution facilities, and sewage treatment plants, is critical to the vitality and sustainability of a populated area. Throughout much of the United States, the existing

infrastructure is old, having been built decades ago, and it has deteriorated to the point that extensive repair and replacement are required. Where new urban and commercial development is occurring, it is critical to construct not only the necessary infrastructure but also connections to nearby existing development. Construction and maintenance of a region's infrastructure requires large amounts of resources. Sufficient resources, however, may not be available for use due to (1) scarcity of local sources, (2) inaccessibility (for example, gravel cannot be mined from under a housing subdivision), or (3) unsuitability of the resource (for example, polluted ground water may be unfit for use as a domestic water supply). The challenge for communities is to adequately factor maintenance and growth of the area's infrastructure into comprehensive land-use plans and to consider how changes in land-use designation can influence the availability of local resources.

The Front Range Infrastructure Resources Project has been designed with input from stakeholders (for example, city, county, and State planning officials, and representatives from industry and universities), not only to improve our understanding of the location and characteristics of resources in the Front Range of Colorado but also to convey objective information about these resources to decision makers and scientists. The Front Range was selected for study for two important reasons. First, it is a region that has experienced tremendous population growth over the last 30 years, with attendant need for resources. Secondly, urban and commercial development has encroached upon areas that are presently or have historically supplied these resources. Thus, the Front Range of Colorado is a natural setting for study of the interplay between the availability of resources required for development and the exclusion of resources due to development of the land.

Image Construction

The image portrays an aerial view from a point approximately 6 miles northeast of Greeley, Colorado (fig. 1), looking in a southwesterly direction from a position estimated to be about 13,000 feet above the ground surface. Because of the elevation and breadth of the view, the image extends beyond the set limits of the FRIRP study area. The image was constructed from accurate maps; however, the map information has been digitally skewed and rotated (see explanation below) to produce an illustration of the urban corridor and adjacent mountain backdrop. Distortion has resulted from digital manipulation of the map information, so the scale across the image is not uniform. Along the eastern or bottom edge of the image, the scale is approximately 1:200,000 (1 inch = 3.2 miles), whereas, at the foothills,

¹The use of trade, product, industry, or firm names in this report is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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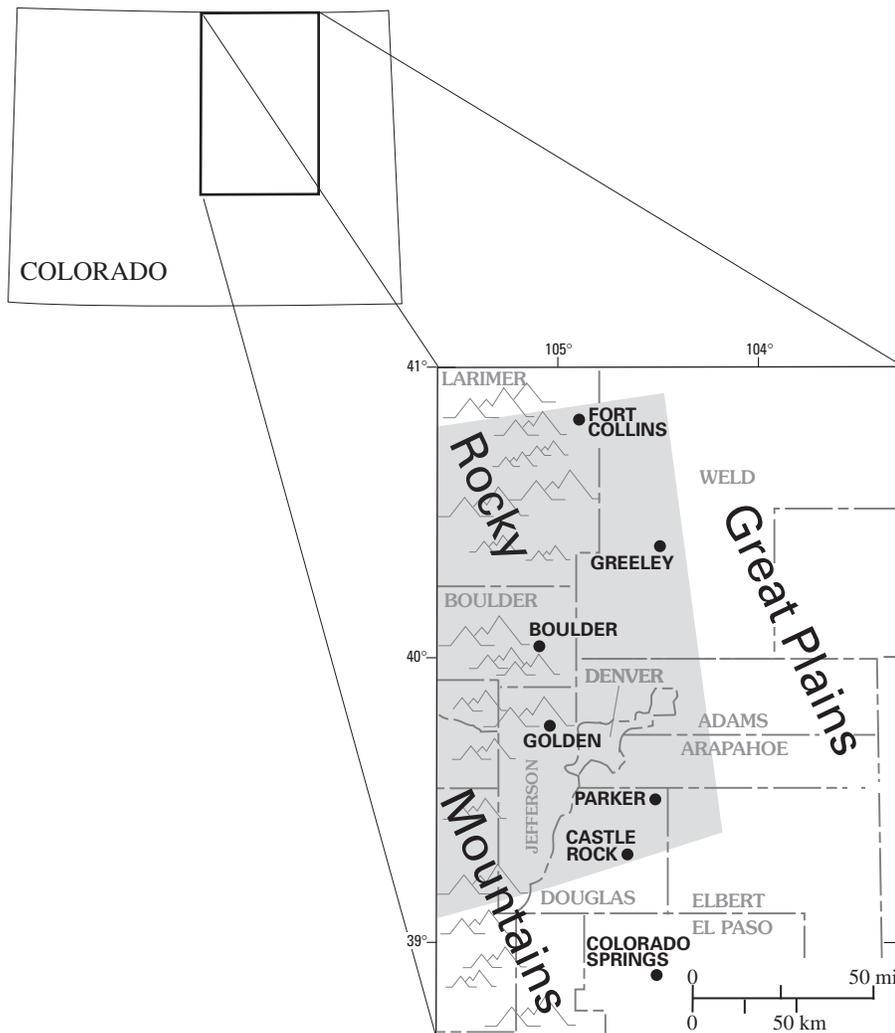


Figure 1. Index map showing the approximate extent of the 3-D image (shaded).

the scale is approximately 1:300,000 (1 inch = 4.7 miles). Thus, the user is advised against attempting to accurately locate features not already shown on the image.

The eastern part of the image was created in a manner that differs from the western part. For the eastern part of the image, which is within the Great Plains (fig. 1), accurate information about the location of roads, streams, rivers, and lakes was taken from U.S. Geological Survey 1:250,000-scale maps (see Sources of Information). Topographic relief in the eastern part of the image is minimal, especially compared to the adjacent mountains; shading along major stream courses was added to enhance the topographic appearance in this part of the image.

Political boundaries, such as city limits, were compiled from multiple sources (see Sources of Information) at different scales to ensure that up-to-date information on these boundaries was used for the image. Information for the Great Plains, including political boundaries, roads, streams, rivers, and lakes, was compiled by hand on mylar and then scanned to produce a digital version of this data.

For the western part of the image, which shows part of the Rocky Mountains (fig. 1), elevation data at 1:250,000 scale (see Sources of Information) were imported into Adobe Photoshop version 5.0. These data served to guide the digitally drafted depiction of the location, shape, and elevation of the

mountains. Finally, the data from the mountain area was merged with the Great Plains part of the image, and the boundary between the two digital data sets was digitally airbrushed to smooth the transition. The merged file was then skewed and rotated using Adobe Photoshop version 5.0. The shear numbers to obtain the skew are negative 45 degrees horizontal and positive 45 degrees vertical. The rotation is negative 30 degrees counter-clockwise. These numbers are applicable only to Photoshop version 5.0, and any attempt to use them in another application might result in error. This digital manipulation resulted in the image in its current form. The image was then placed into an Adobe Illustrator version 8.0 file to allow for the addition of type and overlay information.

Summary

It is our goal that this series of publications provide information about resources in the northern part of the Front Range of Colorado to a wide audience. Although the 3-D image that is the focus of this report is stylized, it was constructed from accurate maps (see Sources of Information). Companion publications in this series will be published in the USGS Geologic Investigations Series (I-2750), and they will use this image as a base map.

These subsequent publications will address topics such as the distribution and quality of resources as well as the effects of resource extraction. We remind those using this image that it was digitally created, rotated, and skewed; we caution against attempting to accurately locate other features on it.

Acknowledgments

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Sources of Information, Great Plains

Colorado Department of Transportation, 1999, Colorado state map: Colorado Department of Transportation, scale 1:950,400 [1 inch = 15 miles].

GeoSystems Global Corporation, [publication date unknown], Colorado road map [large-scale edition]: GeoSystems Global Corporation, scale 1:211,538 [1 inch = 3.3 miles].

Pierson Graphics Corporation, 1999, Front Range Arterial Wall Map: Pierson Graphics Corporation, scale 1:126,720 [1 inch = 2 miles].

Rand McNally, 1999, Road Atlas: Rand McNally, p. 19-21.

U.S. Geological Survey, 1968 [revised 1980], Colorado [topographic map]: U.S. Geological Survey, scale 1:500,000 [1 inch = approximately 8 miles].

U.S. Geological Survey, 1953 [revised 1978], Denver [topographic map]: U.S. Geological Survey, scale 1:250,000 [1 inch = 3.9 miles].

U.S. Geological Survey, 1954 [revised 1976], Greeley [topographic map]: U.S. Geological Survey, scale 1:250,000 [1 inch = 3.9 miles].

Sources of Information, Rocky Mountains

Hubbard Scientific, Inc., 1976, Greeley raised relief map: Hubbard Scientific Inc., scale 1:250,000 [1 inch = 3.9 miles].

Hubbard Scientific, Inc., 1978, Denver raised relief map: Hubbard Scientific Inc., scale 1:250,000 [1 inch = 3.9 miles].

Hubbard Scientific, Inc., 1993, Colorado raised relief map: Hubbard Scientific Inc., scale 1:1,000,000 [1 inch = 16 miles].

U.S. Geological Survey, 1948, Denver mountain area shaded relief map: U.S. Geological Survey, scale 1:190,080 [1 inch = 3 miles].

U.S. Geological Survey, 1969, Colorado shaded relief map: U.S. Geological Survey, scale 1:500,000 [1 inch = approximately 8 miles].